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A Comprehensive Textbook of
**Applied
Nutrition
and Dietetics**
for BSc Nursing Students
Semester II

As per the Revised INC Syllabus

4th
Edition

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Foreword
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Minerals are the cement to build strong bones and teeth.



LEARNING OBJECTIVES

On completion of this chapter students will be able to:

- ✦ Define the minerals. Enlist some common functions of minerals.
- ✦ Classify the minerals.
- ✦ Describe the function, sources, requirement and deficiency diseases of calcium, phosphorus and magnesium.
- ✦ Explain the functions, sources, daily requirements and deficiency diseases of:
 - Sodium
 - Potassium
 - Iron
 - Iodine
 - Fluorine
 - Some trace minerals, i.e., zinc, copper, chromium and selenium.



SELECTED DEFINITIONS

- **Minerals:** Minerals are naturally occurring elements. Our body need to develop and function.
- **Osteoporosis:** This deficiency occur due to deficiency of calcium in common in women bones become porous and fragile.
- **Anemia:** It is deficiency of iron common in women and adolescent girls.
- **Goiter:** Goiter is enlargement of thyroid gland due to lack of iodine.
- **Tetany:** This is a muscular spasm in which calcium rises more than normal level.

INTRODUCTION

- Mineral elements are chemical substances found in body tissues and fluids. They occur in foods as salts, e.g., sodium chloride, calcium phosphate and ferrous sulfate. They constitute 4% of our body weight.

These elements remain ash when plant and animal tissue are ignited.

- More than 50 minerals are found in the human body but a few 24 minerals are associated with clearly recognizable clinical situations in man. Minerals do not provide

energy but they are essential for growth, repair and regulation of body fluids and many other functions. Like vitamins, they are required in small amounts and are vital to the body. They should be supplied daily as they are excreted through the kidneys, bowels and the skin. Minerals are present in the body as follows:

- Components of organic compounds, e.g., hemoglobin contains iron and thyroxin contains iodine.
- As inorganic compounds, e.g., calcium phosphate in the bones and teeth.
- As free ions in every cell of the body.
- In all fluids as soluble salts.

CLASSIFICATION OF MINERALS

Minerals may be classified into three groups:

1. **Major minerals:** Seven minerals are included in this group and they are required in large amounts of over 100 mg/day, e.g., calcium, phosphorus, sodium, chlorine, potassium, magnesium and sulfur.
2. **Minor minerals:** These are required in small quantities, <100 mg/day. They include iron and manganese.
3. **Trace elements:** These are elements required by the body in quantities of less than a few micrograms to milligrams per day, e.g., iodine, zinc, fluorine.

Some General Functions of Minerals

- Minerals form the structural components of bones, teeth, soft tissues, blood and muscles, e.g., calcium, phosphorus and magnesium.
- They regulate activity of nerves with regard to stimuli and contraction of muscles, e.g., calcium.
- Maintain acid-base balance of body fluids, e.g., sodium and chlorine.
- They control water balance by means of osmotic pressure and permeability of cell membranes, e.g., sodium and potassium.
- They are constituents of vitamins, e.g., thiamine contains sulfur and cyanocobalamin contains cobalt.

- They form part of molecules of hormones and enzymes, e.g., iodine in thyroxine and zinc in insulin.
- They activate enzymes, e.g., calcium activates enzyme lipase.
- They regulate cellular oxidation, e.g., iron and manganese.
- They are necessary for clotting of blood, e.g., calcium.

CALCIUM

Among the different minerals, calcium occurs in the highest amounts in the body. It constitutes 1.5 to 2% of body weight. The adult's body contains 1.2 kg of calcium of which 98% is present in bones and teeth and remaining 1% is in soft tissues. The normal amount of calcium in the blood is about 10 mg/dL. There is a dynamic equilibrium between the calcium in the blood and also in the skeleton. This equilibrium is maintained by the interaction of vitamin D, parathyroid hormone and probably calcitonin.

Absorption

Overall about 20 to 30% of dietary calcium is normally absorbed. Absorption of calcium is enhanced by vitamin D and decreased by the presence of phytates, oxalates and fatty acids and fibers in the diet. Dietary calcium which is not absorbed in the intestines is excreted in the urine. The calcium balance is the difference between the quantity of calcium ingested and that excreted in the urine and feces.

Functions of Calcium

- Formation of bones and teeth.
- It helps in blood clotting.
- It maintains the permeability of the capillary walls.
- It regulates the excitability of nerve fibers and nerve centers.
- It is essential for production of milk.
- It regulates contraction and relaxation of muscles including heart muscles.
- It activates a number of enzymes, such as pancreatic lipase.

In short, the calcium ions control many life processes ranging from muscle contraction to cell division.

Sources of Calcium

- Best natural sources are milk and milk products (e.g., cheese, curd, skimmed milk and butter milk), eggs and fish. A liter of cow's milk provides about 1200 mg of calcium.
- The cheapest dietary sources are green leafy vegetables, cereals and millets. The millet *Ragi* is particularly rich in calcium. An additional source of calcium is drinking water which provides up to 200 mg per day. Some fruits like *sitafal* (custard apple) contain good amount of calcium.
- Some important sources of calcium are listed in **Table 8.1**.

Daily Requirements of Calcium

A daily intake of 800 mg of calcium has been suggested for adults. The physiological requirements are higher in children, pregnant and nursing mothers. Indian Council of Medical Research (ICMR) has suggested the following allowances of calcium:

- **Average adult man and woman:** 1000 mg/day

- **Pregnant and lactating woman:** 1200 mg/day
- **Children** between 1–3 years 500 mg/day
- **Infants:** 300 mg/day
- **Children below 10 years:** 600 mg/day
- **Children 10 to 15 years:** 900–1000 mg/day
- **Adolescents:** 1050 mg/day

Deficiency of Calcium

A severe deficiency of calcium in children leads to rickets, and osteomalacia and osteoporosis in adults.

Diseases Due to Calcium Deficiency

Osteoporosis

This is a disease in which bones become porous due to lack of calcium. There is increased susceptibility to fractures. This is often seen in postmenopausal women and can be controlled by weight-bearing exercises (such as walking), calcium supplements and hormone therapy.

Tetany

A decrease in serum calcium level gives rise to condition called tetany. The symptoms of tetany are severe muscular spasm especially of hands and feet. Twitching of facial muscles is also observed.

Treatment

It consists of well-balanced diet with sufficient amount of calcium. One gram calcium along with vitamin D should be given regularly.

PHOSPHORUS

The phosphorus is very essential mineral for the formation of bones, teeth and cell metabolism. An adult body contains 400 to 700 g of phosphorus as phosphates. It occurs along with calcium in human nutrition. It is present in the body in combination of organic and inorganic compounds.

Inorganic phosphorus is present as calcium phosphate in bones and teeth, as sodium and potassium phosphates in body fluids and in soft tissues. The organic

Table 8.1: Important dietary sources of calcium.

Foodstuffs	Calcium content (mg/100 g)
Milk (cow)	120
Milk (buffalo)	200
Curd	120–210
Milk powder (whole)	1200
Milk powder (skimmed)	1350
Cheese	790
Seasame seed	1450
<i>Ragi</i>	300–350
<i>Amaranth</i>	500
Carrot leaves	350
Drumstick leaves	800
Sesbania leaves	1100
Small fish dried	1800

compounds containing phosphorus are phospholipids, nucleic acids and nucleoproteins, hexose phosphates and glycerophosphates, adenosine triphosphates and adenosine diphosphates.

Functions of Phosphorus

- Formation of bones and teeth along with calcium and magnesium.
- It is a constituent of DNA, RNA and nucleic acids.
- As phospholipids, they regulate the absorption and transport of fats.
- Adenosine triphosphate (ATP) and adenosine diphosphate (ADP) are necessary for storing and releasing energy according to body needs.
- As a coenzyme, it is concerned with oxidation of carbohydrates, fats and proteins.
- Phospholipids are the constituents of cell membrane, thus regulate the transport of solutes into and out of the cells.
- Phosphorus containing lipoproteins facilitates the transport of fats in the circulation.
- Inorganic phosphates in the body fluids constitute an important buffer system in the regulation of body neutrality.

Sources of Phosphorus

It is widely distributed in foods. Milk, meat, eggs and fish are rich sources of it. Whole grain, cereals, pulses, nuts and oilseeds also contain good amount of phosphorus.

Absorption and Storage

It is absorbed in the small intestines as inorganic phosphates. Organic phosphorus is hydrolyzed to inorganic phosphate before absorption. It present in animal food, such as milk, meat and eggs is absorbed to a greater extent than that present in cereals and legumes. It is excreted through kidneys. About 10 to 40% of phosphorus is retained in the body. Its retention depends on the quantity ingested, calcium content of the diet and vitamin D

intake. The inorganic phosphorus level in the blood is 2.5 to 4 mg/dL.

Requirements

Expert group suggested that intake of phosphorus should be at least equal to calcium and for infants it should be twice as of calcium.

Deficiency

Phosphorus deficiency is rare since a diet that contains adequate amount of protein and calcium will be rich in phosphorus. Deficiency symptoms are similar to calcium deficiency.

MAGNESIUM

It is a constituent of bones and is present in all body cells. Amount present in the body is much smaller than that of calcium and phosphorus. An average adult human body contains about 25 g of magnesium. About half of this quantity is present in bones in combination with phosphorus and carbonate, chiefly at the surface of the bones and one-fifth of the total is in soft tissues.

Extracellular fluids account for about 2% of the body's magnesium. Normal concentration of magnesium in the blood serum is 2.3 mg/dL.

Functions

- Magnesium is essential for all living cells.
- It is essential for normal metabolism of potassium and calcium.
- It is also essential for skeletal structure.
- It is involved in protein synthesis.
- It is an activator for the enzymes.
- It regulates the nerve impulses and muscle contractions and relaxation along with calcium, sodium and potassium.

Metabolism

The average intake from the diet by adults is about 300 to 400 mg. About 40 to 50% is not absorbed and hence excreted in the stools. About one-third of the amount is excreted in the urine.

Sources of Magnesium

Cereals like *bajra*, barley, wheat, soyabean and grams are good sources of magnesium. Other sources are green leafy vegetables, fruits, egg, meat and fish.

Requirement

See **Table 8.2**.

Deficiency of Magnesium

Its deficiency may occur in chronic alcoholic, cirrhosis liver, protein-energy malnutrition (PEM) and malabsorption syndrome. In one research work, magnesium deficiency was produced in 3 patients. Their clinical features developed were depression, muscular weakness, nervous irritability tremors, vertigo, delirium and liability to convulsions. Their serum level was 1 mg/dL. All clinical symptoms were cured within 4 hours when they were given magnesium chloride.

High Intake

High intake of certain magnesium salt has shown symptoms of extreme thirst, feeling of excessive warmth and drowsiness. This condition is corrected by administration of calcium gluconate.

SODIUM CHLORIDE

- Sodium chloride or common salt is a daily ingredient in our diet. Sodium is the only mineral which is taken in more or less pure form in addition to amount present in natural foods. It is found in all body fluids.

Table 8.2: Daily requirement of magnesium.

Age group	Requirements in mg
Infants	75
Toddlers	135
More than 5 years	150–200
Adult men	385
Adult women	325
Pregnant woman	385
Lactating mothers	325

The adult body contains 100 g of sodium which is present in the extracellular fluid of the body.

- It is excreted from the body in the urine and sweat. About 10 to 15 g sodium is excreted daily in the urine. Absence of sodium in the urine is indication for adding in the subcutaneous tissues. During deprivation the stored sodium is used.

Functions of Sodium Chloride

- It regulates the acid-base balance of the body.
- It maintains fluid balance and normal osmotic pressure between intracellular and extracellular compartments.
- Sodium ions play a special role in originating and maintaining heartbeat.
- It maintains normal irritability of nerves and helps in muscle contraction.

Sources

Milk, egg, meat, poultry, green leafy vegetables, Bengal gram, beetroot, coffee, tea, nuts and raisins (dry) are good sources of sodium chloride. The sodium from additives should also be included. Milk, spinach and non-vegetarian foods are rich sources.

Requirements

Requirement of sodium depends on climate and occupation of person. Recommended allowances are as follows in **Table 8.3**.

Deficiency

A deficiency is seen in people engaged in heavy physical activities, such as farmers,

Table 8.3: Daily requirement of sodium chlorides.

Age group	Requirements in g
Children	5–10 g
Adolescents	8–10 g
Pregnancy	10–12 g
Lactation	10–15 g
Heavy worker	15–20 g
Average adults	5–10 g

mine workers and athletes. It may also occur in cases of severe vomiting or diarrhea. It results in weakness and muscle cramps. It can be treated by adding salt to water or lime juice. If this is not retained, intravenous saline could be given.

Excess Intake of Sodium

An excessive intake of sodium should be avoided as it predisposes to edema and hypertension.

POTASSIUM

It is present as the major electrolyte in body cells. The adult human body contains about 250 g potassium. Major portion is present in the cells. Plasma contains traces only whereas RBC contains large amount.

Functions

- It regulates the acid-base balance like sodium.
- It regulates the osmotic pressure of the cells.
- It helps in transmitting nerve impulses and contraction of muscle tissues.

Daily Requirements

The daily requirement of potassium has not been determined accurately.

Sources

All cereal, grains and green leafy vegetables contain 300 to 600 mg potassium. Lentil contains 400 mg, spinach 550 mg and dry peas contain 980 mg. Other good sources of potassium are carrot, radish, sweet potatoes, raisin, almond, groundnut and sea coconut contains about 700 mg. Coffee, tea and cocoa are the richest sources as they contain 1500 to 2000 mg.

Deficiency

Deficiency of potassium is unlikely in normal circumstances but may occur in severe malnutrition, chronic alcoholism, surgery and patients on diuretics. Symptoms are the same

as in sodium deficiency, such as weakness, muscular cramps.

IRON

Iron is of great importance in human nutrition. The adult human body contains 3 to 4 g of iron, of which 70% is present in the blood as circulating iron and the rest as storage iron. Each gram of hemoglobin contains about 3.34 mg of iron. Most of the body iron exists in complex forms bound to protein either as porphyrin or heme compounds or as ferritin and transferrin. Free inorganic iron occurs in the body only in very small amounts.

Functions of Iron

- The central function of iron is oxygen transport and cell respiration.
- It is an essential part of several oxidative enzymes.
- It is necessary for formation of hemoglobin, brain development, regulation of body temperature and muscle activity.
- It facilitates the complete oxidation of carbohydrates, proteins and fats within the cell and release of energy for performing physical work.

Absorption

- Iron is mostly absorbed from duodenum and upper small intestine in the ferrous state according to the body needs. The different factors affecting the absorption of iron are as follows:
 - Iron in the ferric state will have to be reduction ferrous state before absorption.
 - Vitamin C from the diet and hydrochloric acid in gastric juice helps in converting ferric iron to ferrous iron, thus enhances the absorption of iron.
 - Excess of calcium, phosphates, phytates, oxalates, interferes in the absorption of iron.
- In the period of extra demand or when there is deficiency, the rate of absorption

is increased. Complete proteins, such as meat favor absorption.

- The absorbed iron is transported as plasma ferritin and stored in liver, spleen, bone marrow and kidney. When red cells are broken down, the liberated iron is reutilized in the formation of new red cells.

Iron Losses

Iron is required for replacement of daily loss through urine, sweat, bile and worn out cells. This is called basal losses. The total daily iron loss of an adult is about 1 mg and about 2 mg in menstruating women. Second route of iron loss is through hemorrhage. It may be due to injury, worm infestation and child birth among women.

Daily Requirements of Iron

Because of the recycling of iron, only a small amount of iron is needed by the body. Its requirement is increased during rapid expansion of tissues, e.g., during pregnancy, childhood and adolescence girls. Recommended allowances for iron according to ICMR are given in **Table 8.4**.

Sources of Iron

Diet provides iron in two forms:

1. **Heme iron**, i.e., iron associated to protein, globin. This iron is found in flesh food only, such as liver meat, fish and poultry. They are not only important sources of readily available iron but they also promote the

absorption of nonheme iron in plant food eaten at the same time. The iron content of milk is low.

2. **Nonheme iron** is tightly bound to organic molecules in the form of ferric iron. These are of vegetable origin, e.g., cereals, green leafy vegetables, legumes, oilseeds, dried fruits and jaggery. Nonheme iron is poor in its bioavailability because of the presence of phytates, oxalates, carbonates, phosphates and dietary fibers which interfere in its absorption.

Iron Deficiency

Three stages of iron deficiency have been described. *First stage* is characterized by decreasing storage of iron without any other detectable abnormality. In *second stage*, 'latent iron deficiency', iron stored are exhausted but anemia has not occurred as yet. Its recognition depends upon measurement of serum ferritin levels. This stage is most widely prevalent stage in India. The *third stage* is characterized by decreased concentration of circulating hemoglobin. This stage is known as nutritional anemia. Besides, anemia, there may be other disturbances, such as reduced resistance to infection and decreased work performance.

Signs and Symptoms of Anemia

- Reduced hemoglobin, i.e., less than 9 g percentage.
- The clinical features are general fatigue, pallor skin, breathlessness on exertion. In severe condition, there may be edema on the ankles. In weaned infant and young children, there may be poor appetite along with pallor skin. Their growth and development will be retarded due to low food intake.

Prevention and Treatment

- Growing children, menstruating girls and pregnant women should get supplementary iron due to increased demand of their body.
- Nutrition education regarding cheap and good sources of iron and importance of

Table 8.4: Recommended daily allowances of iron (ICMR 2020).

Age group	Iron in mg/kg body weight
Infant	0.5 mg/kg body weight
1–12 years	15–18 mg
13–18 years boys	26
13–18 years girls	32
Men (average)	19
Women	28
Pregnancy	35
Lactation	23

iron in diet, etc., will help to reduce iron deficiency anemia in the community and among school children.

- To reduce this problem, a National Programme for the Prevention of Nutritional Anemia was launched by the Government of India. The program consists of distribution of iron and folic acid tablets to pregnant women, young children and menstruating girls through all health centers. One tablet of iron and folic acid containing 60 mg elementary iron + 180 mg of ferrous sulfate and 0.5 mg folic acid should be given daily for 100 days. Commercial production of iron fortified salt was also started in 1985.
- Encourage the community people to add sufficient amount of green leafy vegetables in their diet.

IODINE

Iodine is an essential micronutrient. It is required for the synthesis of the thyroid hormones, thyroxine (T_4) and triiodothyronine (T_3). T_3 and T_4 are composed of two molecules of tyrosine combined with 3 or 4 atoms of iodine. Thyroid hormones regulate the rate of oxidation within the cells and influence physical and mental growth, functioning of nervous and muscle tissues, circulatory activity and metabolism of all nutrients. It is required in minute amount (microgram).

An adult's body contains 50 mg of iodine. In the blood, its level is 8 to 10 μg . About one-third of the iodine is found in the thyroid glands where it is stored in the form of thyroglobulin.

Functions of Iodine

- It is essential for thyroid glands to produce T_3 and T_4 hormones.
- As a constituent of thyroxine, it regulates the rate of oxidation in the cell and determines the rate of metabolism.
- It is also essential for physical and mental growth.
- It is needed for proper bone and brain development during pregnancy and infancy.

Requirement of Iodine

- For infants = 100 to 120 microgram (μg)
- Children 2 to 10 years = 120 μg
- Above 10 years and adults = 150 μg
- Pregnant = 250 μg
- Lactating women = 280 μg
- Above amount is normally supplied by an ordinary diet and drinking water.

Digestion and Absorption

- It is ingested in food as inorganic iodides and as organic compounds. In digestive tract, iodine is split from organic compounds and is rapidly absorbed as inorganic iodide. The degree of absorption depends upon the level of circulating thyroid hormone.
- Thyroid activity is controlled by thyroid stimulating hormone (TSH) which is secreted by the anterior lobe of pituitary gland. TSH is stimulated by thyroid releasing hormone (TRH) which is synthesized in the hypothalamus and secreted into the pituitary. TSH is stimulated when blood concentration of thyroid hormone falls. TSH increases the activity of thyroid gland. Thyroid gland removes iodide from circulation, concentrates it and eventually uses it to synthesize T_3 and T_4 .
- After thyroid, hormones are used in the body tissues for cellular oxidation, iodine is released in the circulation. About one-third of released iodine is again incorporated into the thyroid gland and remainder is excreted in the urine.

Sources of Iodine

- The best sources of iodine are sea foods, i.e., sea fish, sea salt and cod liver oil. Smaller amounts in other foods, e.g., milk, meat, fresh water vegetables and cereals.
- The important dietary source is iodized salt. One teaspoon salt provides 95 μg of iodine. Foods grown in the soils near the sea coast are good sources of iodine.

Ninty-five percent iodine comes from food eaten and remainder from drinking water. The soil of mountainous regions usually contains less amount of iodine.

Deficiency Disorders

Iodine deficiency occurs in those areas in which the iodine content of soil is low and no provision is made for supplying iodized salt. In India, the soil of Kangra in the Himalayan belt is deficient in iodine.

Goiter

Deficiency of iodine results in goiter. If intake of iodine is inadequate, the stores of thyroxine are gradually depleted and the thyroid gland enlarges in an attempt to produce the necessary thyroxine. This enlargement is called goiter. No other abnormal physical findings are associated with it. Basal metabolic rate (BMR) in normal deficiency is more prevalent in females than males and more frequent during adolescents and pregnancy (Fig. 8.1A).

Cretinism

This condition occurs in infants when the pregnant women are severely depleted in iodine. This is a severe condition characterized by a low BMR, muscular flabbiness, weakness,

dry skin, enlarged tongue, thick lips, arrest of skeletal growth and severe mental retardation. Thyroid hormone given early to the infants gives good results (Fig. 8.1B).

Other Deficiency Diseases

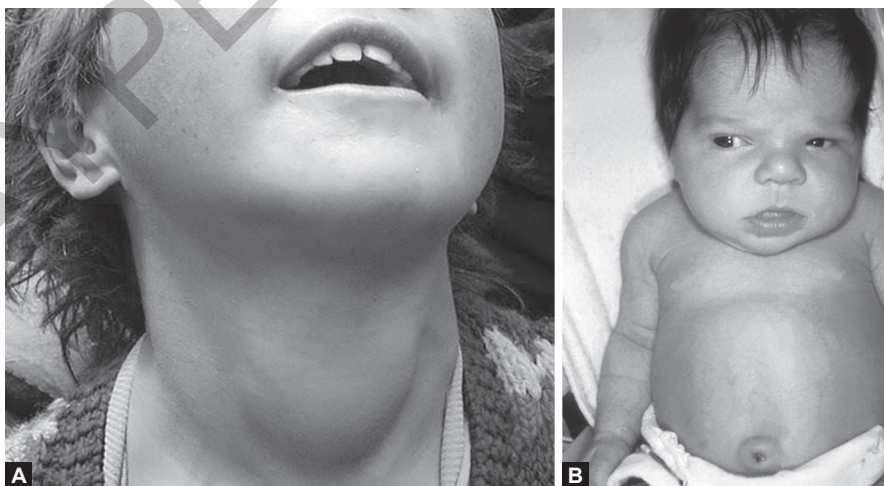
- Increased rates of spontaneous abortions and stillbirths are reported due to deficiency of iodine during pregnancy.
- Neurological cretinism including deafness and mutism. Myxoedematous cretinism including dwarfism.

Goitrogens

These are chemical substances in food known to interfere with the use of thyroxine and can lead to occurrence of goiter. They are present in red skin of peanuts and in vegetables, such as cabbage, turnips, radish, cauliflower and mustard seeds. These can be inactivated by cooking.

Prevention and Control of Iodine Deficiency Disorders (IDD)

Indian government has started the National Goiter Control Programme in 1962 in the conventional goiter belt in the Himalayan region. Then in 1986, a major national program, the IDD Control Programme was



Figs. 8.1A and B: Iodine deficiency diseases: (A) Goiter; (B) Cretinism.

(For color version, see Plate 2)

mounted with the objective to replace the entire salt by iodized salt in a phased manner. Four essential components of this program are iodine monitoring, manpower training, mass communication and iodized salt.

Mass communication and education is a powerful tool to make the people aware of iodine deficiency diseases and its prevention by using iodized salts and other available sources of iodine.

FLUORINE

Fluorine is the most abundant element in nature and is the normal constituent of the body. Being so reactive, it is always found in combined form. About 90% of the fluoride in the body is found in bones and teeth. Interest in the importance of fluorine in nutrition was created by the discovery of high incidence of chronic endemic fluorosis in man and farm animals in 1931 in certain parts of India.

Functions

It is essential for the normal mineralization of bones and formation of dental enamel. This tooth enamel is resistant to action of acids produced by bacteria in the mouth.

Daily Requirement

- The recommended level of fluorides in drinking water in this country is accepted as *0.5 mg* per liter.
- In the temperate countries where the water intake is low, the optimum level of fluorides in drinking water is accepted as *1 to 2 mg* per liter.

Sources

The principal sources of fluorine available to man are drinking water and food.

Drinking Water

The major source of fluorine is drinking water. In most parts of India, the fluoride content of drinking water is about *0.5 mg* per liter, but in fluorosis endemic areas it may be as high as 3 to 12 mg/L.

Food

Foods, such as sea fish, eggs, cheese, tea and milk are reported to be rich in fluorides.

Deficiency of Fluorine

A deficiency of fluorine results in dental caries and is seen in areas where drinking water contains less than *0.5 mg* of fluorine per liter. Addition of fluorine to drinking water at a level of *1 mg* per liter brought about a significant reduction in the incidence of dental caries in a study carried on dental caries.

Excessive Intake; Fluorosis

Fluorine is often called two edged sword. Prolonged ingestion of fluorides through drinking water in excess of the daily requirement is associated with dental and skeletal fluorosis. Dental fluorosis or mottling of teeth occurs in parts of the world where drinking water contains excessive amounts of fluorine. Teeth lose their lustrous appearance. Enamel becomes dull and chalky, white patches with secondary infiltration of yellow or brown staining are found on the surface of the teeth.

The enamel is structurally weak and in severe cases, there is marked loss of enamel accompanied by pitting which gives the tooth surface a corroded appearance.

Skeletal Fluorosis

Chronic fluorine intoxication through drinking water containing excessive amounts of fluorine results in pathological changes in bones. There is (sclerosis) increased density and hypercalcification of the bone of the spine, pelvis and limbs. In addition, the ligaments of the spine become calcified and producing a 'poker back'. Such persons are crippled and cannot perform simple daily tasks, such as bending, squatting, etc., as the joints become stiff.

Prevention of Fluorosis

Fluorosis can be prevented by removing fluorine from the water supplies by treatment

with activated carbon or by some other suitable adsorbents.

OTHER TRACE ELEMENTS

Zinc

Zinc is a component of many enzymes. It is present in small amounts in all tissues. Bones, teeth and pancreas contain slightly higher amounts than other tissues. Whole blood contains about 0.7 mg/100 mL and plasma 0.1 mg/100 mL. The average adult body contains 1.4 to 2.3 g of zinc.

Functions

- It is essential for the synthesis of insulin by the pancreas and for the immunity function.
- It is a constituent of many enzymes, e.g., alkaline phosphatase.
- It is a constituent of insulin, the hormone present in the islets of Langerhans of pancreas.

Daily Requirements

- **Adult man:** 17 mg/day
- **Adult women:** 13 mg/day
- **Infants:** 2.5 mg/day
- **Children:** 5–10 mg/day
- **Pregnant and lactating women:** 15–18 mg/day

Sources

It is widely distributed in foodstuffs both animal and vegetables. The bioavailability of zinc in vegetable foods is low. Animal foods, such as meat, milk and fish are dependable sources.

Deficiency

Zinc deficiency is common in children in India due to lack of intake of animal food and high dietary phytate content. Severe maternal deficiency results in spontaneous abortion congenital malformations like anencephaly. Zinc deficiency has been reported to result in growth failure and sexual infantilism in adolescents. Delayed wound healing and loss of taste are other

manifestations. There are also reports of low circulating zinc level in clinical disorders, such as liver disease, thalassemia and myocardial infarction.

Preventions

Zinc supplement in combination with ORS has been shown good results. So Indian Government has started this under National Diarrhea Control Programme.

Antioxidants

Antioxidants are substances both nutrients and nonnutrients, such as vitamins E, C, A.

Copper

Copper is widely distributed in nature. Even poor diets provide enough copper for human needs. It is a constituent of several enzymes and is found as a complex with some proteins in blood. The healthy human adult body contains about 100 to 150 mg of copper. High intake of Indian diet may be due to contamination of copper from brass vessels used in cooking.

Daily Requirements

For adult, it is 1000 microgram per day. Requirement is increased during pregnancy and lactation, i.e., 1300 microgram/day.

Deficiency

Deficiency or excess of this element is very rare. Copper deficiency is likely to occur only in infants as anemia who are fed exclusively on milk diet. Its deficiency is also observed in patients with nephrosis and PEM. Neutropenia is the abnormality of copper deficiency.

Excess

Hypercupremia may result in from eating food prepared in copper cooking vessels. It may be associated with several acute and chronic infections, such as leukemia, Hodgkin's disease, hyperthyroidism and myocardial infarction. A genetic disease characterized by excess copper accumulation in children is known as Wilson disease.

Cobalt

It occurs in small amounts in all tissues, highest concentration occurring in liver and kidneys. Most of the cobalt is present in vitamin B₁₂. The only established function of cobalt in the human is as a part of the vitamin B₁₂ molecules which must be ingested. There is no evidence as yet of cobalt deficiency in man. Recently, cobalt deficiency and cobalt iodine ratio in the soil have shown to produce goiter in humans.

Chromium

Chromium plays an important role in carbohydrate, lipid and protein metabolism. Total body content of chromium is small, less than 6 mg. There is suggestive evidence

that chromium plays a role in relation to carbohydrate and insulin function. Chromium deficiency is characterized by impaired growth and disturbances in glucose, lipid and protein metabolism. The exact requirements are not known. Average diets appear to meet the chromium requirements.

Selenium

Until recently, little attention had been given to selenium in human nutrition. Studies indicate that human selenium deficiency may occur in PEM. Its deficiency when combined with vitamin E deficiency reduces antibody production. Selenium administration to children with kwashiorkor results in significant weight increase.



REVIEW QUESTIONS

Long Answer Questions

- Write the classification of minerals.
 - Enlist the general functions of minerals.
- Discuss the deficiencies of the following:
 - Calcium.
 - Iron.
 - Iodine.
- Write short note on the following:
 - Functions of phosphorus.
 - Functions of calcium.
 - Prevention and treatment of anemia.

Fill in the Blanks

- _____ is caused by excessive intake of fluorine.
- _____ is the deficiency of iodine in children.
- Excessive intake of sodium chloride leads to _____.
- As adults body contains _____ mg of iodine.
- Sea foods are the best sources of _____.

Multiple Choice Questions

- How many minerals are included in the group of major minerals?
 - 10
 - 8
 - 3
 - 7

2. Minor minerals are required daily:
 - a. <100 mg
 - b. >100 mg
 - c. >200 mg
 - d. On demand
3. Following are the trace minerals:
 - a. Iodine
 - b. Zinc
 - c. Fluorine
 - d. All of above
4. The adult's body contains how much calcium:
 - a. 2.1 kg
 - b. 1.2 kg
 - c. 1.5 kg
 - d. 2.5 kg
5. Osteoporosis results from deficiency of:
 - a. Vitamin E
 - b. Vitamin C
 - c. Vitamin K
 - d. Calcium
6. Following minerals are essential for bone formation:
 - a. Iodine and zinc
 - b. Calcium and phosphorus
 - c. Iron and zinc
 - d. Sodium and potassium
7. Deficiency of calcium leads to:
 - a. Tetany
 - b. Marasmus
 - c. Osteoporosis
 - d. Pellagra
8. Anemia is caused by deficiency of:
 - a. Vitamin C
 - b. Thiamin
 - c. Riboflavin
 - d. Iron
9. Deficiency of Iodine in adults leads to:
 - a. PEM
 - b. Goiter
 - c. Scurvy
 - d. Dehydration
10. Fluorosis is disease caused by excessive intake of:
 - a. Iron
 - b. Calcium
 - c. Fluorites
 - d. Fats

ANSWER KEYS

Fill in the Blanks

- | | | | |
|--------------|--------------|----------|----------|
| 1. Fluorosis | 2. Cretinism | 3. Edema | 4. 50 mg |
| 5. Iodine | | | |

Multiple Choice Questions

- | | | | |
|------|-------|------|------|
| 1. d | 2. a | 3. d | 4. b |
| 5. d | 6. b | 7. a | 8. d |
| 9. b | 10. c | | |

A Comprehensive Textbook of Applied Nutrition and Dietetics

Salient Features

- This book is based on the revised syllabus of BSc Nursing by INC (2021) and revised RDAs by ICMR (2020).
- It will also be helpful for diploma and postgraduate nurses.
- Content is presented with clarity and full of explanation for each topic.
- Each chapter includes learning objectives, definitions, daily requirements, flowcharts, deficiency disorders, and role of nurses in prevention and treatment.
- At the end of each chapter, review questions (subjective and objective) with answer keys are added for practice of students.

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In 2005, she took voluntary retirement from the government job and joined private sector as Professor, Khalsa College of Nursing, and as Principal, CKD International Nursing College, Amritsar. She worked for 20 years in both the institutes. She organized and attended many national and international conferences and presented her papers. She was honored with PhD Nursing in 2012. She is a life member of TNAI, NRSI, SOCHNI nursing scholar society and many more. She received many awards at district and state levels for her best services to the community. She was honored with President Award in 2018 for her outstanding professional, academic, and social services. She received this National Florence Nightingale Award from Mr Ram Nath Kovind, President of India, in President Bhawan, New Delhi.



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